success) to describe its structure. We know it is more than merely a chemical compound. It is a historical substance. A watch, as such, is not. The metal and parts of which a watch is made, have, it is true, a past history; but the watch comes from the hands of its maker *de novo*, without any past history *as a watch*. But not so the plant cell. It has an ancestry *as a cell;* its protoplasm has what we may call a physiological memory of the past. It is what it is, not merely because of its present condition, but because its ancestral cells have had certain experiences. We can never understand a plant protoplast merely by studying it; we must know something of its genealogy and its past history.

It will be noted that although a physiologist in outlook, he has properly emphasized the historical and structural point of view so often and so deplorably neglected by the cultivators of disembodied plant physiology. The author obviously considers that living matter is to be studied *in vita* rather than *in vitro* (whether in glass models or merely in chemical glassware). By his broad outlook he has avoided the narrows which lead, on the one hand, into the ancient Scylla of systematic botany, or, on the other, into the more modern Charybdis of plant physiology.

The book is admirably printed on thin paper, so that its more than six hundred pages and well over four hundred illustrations make a conveniently thin and flexible volume, which is rendered still more useful by soft covers and rounded corners. The illustrations, whether original or borrowed, are for the most part good, and in some instances are of striking excellence. An adequate amount of space is given to the important themes of genetics and evolution, while the historical side is not neglected. Dr. Gager's work should be in the hands of every teacher of botanical science, and by its broadness and balance is admirably adapted for use in schools where the one-sided teaching of the facts of botany is by necessity and common sense excluded. The general text is accompanied by a laboratory guide, which is ingeniously contrived to avoid repetition and equally emphasizes structure and function.

E. C. Jeffrey

SPECIAL ARTICLES

WHY CHLOROFORM IS A MORE POWERFUL AND DANGEROUS ANESTHETIC THAN ETHER

Any one accustomed to administering anesthetics has observed that the amount of chloroform necessary to produce deep narcosis is less than that of ether; also that the period between slight and deep anesthesia is shorter and the lethal dose smaller with chloroform than with ether. These differences in the effects of ether and chloroform led Hewitt to state in his book on "Anesthetics" that chloroform is seven or eight times more powerful as an anesthetic than ether. In chloroform poisoning it is known that many of the organs, particularly the liver, are very seriously injured, while it is more difficult, or impossible in many instances, to produce such injuries with ether.

It is now recognized that in both chloroform and ether anesthesia oxidation is decreased or rendered defective, as is indicated by the decreased oxygen intake and carbon dioxide output and the appearance of certain incompletely oxidized substances such as β-oxybutyric and diacetic acids, and acetone. The decreased oxidation in anesthesia with resulting acidosis is much more likely to occur and to a much greater extent with chloroform than with ether.

Using practically all the means by which it is known that oxidation can be increased in an animal, as, for example, by food, by increasing the amount of work, by fight, or by thyroid feeding, we have found that there is always an accompanying increase in catalase, an enzyme in the tissues which possesses the property of liberating oxygen from hydrogen peroxide. We have also decreased, or rendered defective, the oxidative processes in animals, as, for example, by decreasing the amount of work, by starvation, by phosphorus poisoning, or by extirpation of the pancreas, thus producing diabetes, and have found that there is always a corresponding decrease in catalase. From these results it was concluded that it is probable that catalase is the enzyme in the body principally responsible for oxidation.

The object of the present investigation was to determine if catalase is decreased more quickly and more extensively during chloroform anesthesia than during ether anesthesia parallel with the greater decrease in oxidation and the quicker and more powerful action of chloroform. Cats were used in the experiments. The anesthetics were administered by bubbling air through ether or chloroform in a bottle which was connected by a rubber tube to a cone adjusted to the snout of the animal. The catalase content of the blood, taken from the external jugular vein, was determined before the administration of the anesthetic and at intervals of 15 minutes during the administration. The determinations were made by adding 0.5 c.c. of blood to 250 c.c. of hydrogen peroxide in a bottle at 22° C. and as the oxygen gas was liberated it was conducted through a rubber tube to an inverted graduated cylinder previously filled with water. After the volume of gas thus collected in ten minutes had been reduced to standard atmospheric pressure, after resulting volume was taken as a measure of the amount of catalase in the 0.5 c.c. of blood. The bottles were shaken in a shaking machine during the determinations at a rate of about 180 double shakes per minute.

The average amount of oxygen liberated by the blood of three cats previous to the administration of ether was 812 c.c.; that liberated after the animals had been under ether for 15 minutes was 740 cc.; that after 30 minutes of ether anesthesia, 630 cc.; that after 45 minutes, 475 cc.; that after 60 minutes, 480 cc.; after 75 minutes, 400 cc.; and that after 90 minutes, 380 cc. It will be seen that the catalase of the blood was gradually decreased during the 90 minutes of ether anesthesia, as is indicated by the gradual decrease in the amount of oxygen liberated, and that at the end of 90 minutes the catalase had been decreased by about 54 per cent., as is indicated by the decrease in the amount of oxygen liberated from 812 cc. to 380 cc.

Similarly determinations were made of the catalase of the blood of cats previous to chloroform anesthesia and at intervals of 15 minutes during the anesthesia. The average amount of oxygen liberated by the blood of three cats previous to the administration of chloroform was 900 c.c; that liberated after the animals had been under chloroform anesthesia for 15 minutes was 525 c.c.; that after 30 minutes, 325 c.c.; that after 45 minutes, 334 c.c.; that after 60 minutes, 320 c.c.; after 75 minutes, 330 c.c.; and that after 90 minutes, 310 c.c. It will be seen that the chloroform produces a very abrupt decrease in the catalase of the blood during the first fifteen minutes of the administration as is indicated by the decrease in the amount of oxygen liberated from 900 to 525 c.c., and that at the end of 90 minutes the catalase had been decreased by about 65 per cent., as is indicated by the decrease in the amount of oxygen liberated from 900 to 310 c.c.

By comparing the decrease in the catalase produced by ether and by chloroform it will be seen that the ether produced a gradual decrease as is indicated by the gradual decrease in the amount of oxygen liberated by 0.5 c.c. of the different samples of blood from hydrogen peroxide, whereas chloroform produced a very abrupt decrease during the first fifteen minutes of narcosis as is indicated by the great decrease in the amount of oxygen liberated from 900 to 325 c. c.

We have shown that small amounts of chloroform or ether added to blood in vitro destroy the catalase of the blood very rapidly. We have also shown that the liver is the organ in which catalase is formed, given off to the blood carried to the tissues.

The explanation that suggests itself for the decrease in the catalase of the blood produced during chloroform and ether anesthesia is the direct destruction of the catalase of the blood by the anesthetic and the decrease output of the catalase from the liver brought about by injury of the liver by the anesthetic. The more powerful and dangerous effect of chloroform as an anesthetic is attributed to the fact that chloroform is more potent than ether in producing a decrease in catalase, both by direct destruction of the catalase of the blood and by injuring the liver, thus decreasing the

output of catalase from this organ with resulting decrease in oxidation. In fact it is probable that the cause of anesthesia is to be found in the decrease in the oxidative processes particularly of the nervous system produced presumably by the destruction of the catalase by the anesthetic. The specific action of anesthetics on the nervous system, according to this hypothesis, is due to the greater solubility of the lipoids or fat-like substances of nervous tissue which facilitates the entrance of the narcotic into the nerve cell and thus exposes the contained catalase more directly to the destructive action of the drug.

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THE AMERICAN ASSOCIATION OF VARIABLE STAR OBSERVERS

The formal organization meeting of the American Association of Variable Star Observers was held at the Harvard College Observatory, Cambridge, Mass., on November 10th and was attended by 25 or more members, almost all of whom are active participants in the observation of variable stars. The meeting was called to order by Wm. Tyler Olcott, who for the past six years has acted as secretary of the informal association, and A. B. Burbeck was appointed temporary chairman. A carefully drawn up constitution was read and accepted and then the officers and council members of the association were duly elected. D. B. Pickering, of East Orange, N. J., was elected president; H. C. Bancroft, Jr., of West Collingswood, N. J., vice-president; W. T. Olcott, of Norwich, Conn., secretary, and A. B. Burbeck, of North Abington, Mass., treasurer. The four members of the council are Professor Anne S. Young, of Mt. Holyoke College Observatory, J. J. Crane, of Sandwich, Mass., for two years, and Miss H. M. Swartz, of South Norwalk, Conn., and C. Y. McAteer, of Pittsburgh, Pa., for one year.

While waiting for the result of the election to be announced by the tellers, a general discussion of the most suitable size of telescope for the use of the observers was opened up, and later, a discussion of plans for the most systematic observation of the 300 or more variable stars under research was also freely indulged in.

In taking the chair as the first president of the association, Mr. Pickering reviewed, in a few words, the past achievements of the Variable Star Observers, and mentioned their aims for the future.

Tea was kindly served by the director of the observatory in the afternoon, and then lantern slide exhibits were given, one by Miss A. J. Cannon, showing some of the celestial wonders as revealed in the photographic telescopes, and another by Mr. Leon Campbell, illustrating the progress of the study of the star SS Cygni and what attempts are being made to fathom its seemingly irregular variations, both in light and period.

While an inspection of the work of the observatory was being made, the more experienced members observed this same SS Cygni in the comfortable 12-inch Polar Telescope, all under like conditions, and the result of the estimates of the 17 observers was that the star was then of the magnitude 11.21, with a probable error of 0.12 magnitude.

At a short meeting of the council, three noted variable star observers were elected to honorary membership, Professor E. C. Pickering, director of the Harvard Observatory; Rev. J. G. Hagen, director of the Vatican Observatory, Rome, and Professor J. A. Parkhurst, of the Yerkes Observatory. Professor Pickering was also elected as the first patron of the association.

The council also elected nine members to life membership and the total membership therefore numbers 84, of which 72 are active; 9, life, and 3 are honorary members, with 1 patron.

A sumptuous banquet was served in Boston that evening at which 20 members and four guests were present. Interesting after dinner speeches were made by Professors Pickering and Bailey, and Miss Cannon and Mr. Olcott, Mr. Campbell acting as toastmaster.

The meeting was considered the climax of all those yet held and marks the successful launching of a full-fledged association in America for the regular observation of variable stars by a group of amateur and professional astronomers, which has been doing excellent work along this line for some years past, and which bids fair to be even more useful to science in the near future.

Several committees were appointed by the president to consider the matter of telescopes, charts and schemes of work, and it was voted by the council to hold the spring meeting at East Orange, N. J., on May 6, 1918, at the invitation of President Pickering.

For those members who remained in Boston until the next day, an excursion was arranged to